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ABSTRACT

Twenty-six university-based ITV systems, some live and some utilizing videotape, were identified and queried as part of a study on "Cost Effectiveness of Continuing Engineering Studies by Television." An analysis of these systems shows that, in properly planned, implemented, and mature systems, the cost of off-campus student instruction by TV can be significantly lower than serving the equivalent students on campus. By far most respondents, from both institutions and industry, report favorable experiences and attitudes toward their ITV involvement. Financial visibility is made more likely when auditors--with or without grades and tests--and nonengineering courses are included in the program. The Stanford ITV system demonstrates the success possible. Finally, four hypothetical cases illustrate the need for cost studies and comprehensive planning before choosing any specific delivery approach. (WH)

FINAL REPORT
ON
COST EFFECTIVENESS
OF
CONTINUING ENGINEERING
STUDIES BY TELEVISION

TO

CONTINUING ENGINEERING STUDIES DIVISION
AMERICAN SOCIETY OF ENGINEERING EDUCATION

BY

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SUMMARY

Twenty six (26) university based ITV systems, some live and some utilizing video tape were identified and queried as part of a study on "Cost Effectiveness of Continuing Engineering Studies by Television." An analysis of these systems shows that, in properly planned, implemented and mature systems, the cost of off-campus student instruction by TV can be significantly lower than serving the equivalent students on-campus. Almost always there is a transient "start-up" phase where student participation does not cover all incremental ITV costs.

By far most respondents, from both institutions and industry, report favorable experiences and attitudes towards their ITV involvement. Most will recommend involvement by others under the proper conditions. When ITV is vigorously promoted and when the institution is responsive to the realities of the user environment, participation and income exhibit clear and significant patterns of growth.

Where on-campus instruction is shared with remote students for credit, not-for credit but with testing and grading and with auditors; and where it includes courses other than just engineering in order to maximize both service to the community and financial return to the institution, the prospects of financial viability increase. There is a growing tendency to provide such expanded services.

It is shown that it is possible to accrue a significant surplus of income over incremental costs where the incremental costs relate to the remote students sharing on-campus instruction, and where only the incremental teaching, capital cost amortization and TV operating costs required to service the remote students are considered.

Using the Stanford ITV system as an example, the remarkable impact on energy conservation, the environment, safety and dollars of using telecommunications as a substitute for automobile transportation is clearly demonstrated.

Finally, by treating four hypothetical cases which compare the cost of video tape delivery systems with rf delivery systems, the need for detailed cost-trade off studies and comprehensive system planning before choosing any specific delivery approach is clearly indicated. These cases utilize cost data from CSU, Stanford and TAGER which may be useful (guidance only) in the preliminary system planning of other institutions.

TABLE OF CONTENTS

I - INTRODUCTION

On January 17, 1973, the Executive Board of the Continuing Engineering Studies Division of the American Society of Engineering Education (ASEE) authorized the formation of a Task Force to study "The Cost Effectiveness of Continuing Engineering Studies by Live Television." The Task Force was activated by April 9, 1973. This represents its final report.

The Task Force decided that "live" television (TV) too narrowly bounded the scope of the study and the potential interest of ASEE members. Therefore, the study has surveyed all ITV systems, whether "live" or by video tape (cassette).

The Task Force chose, for the purpose of its study, to define "continuing engineering studies" as including all programs, both for credit and not-for-credit, by which an institution provided education by TV to students remote from campus.

Cost-effectiveness is normally defined as the benefit/cost ratio. However, for the purpose of this report, the cost/benefit ratio will be used as a measure of comparison between TV systems and between TV and on-campus costs. This cost/benefit factor can be directly related to Terman's (1) "instruction cost index,*" which he uses as a measure of faculty productivity. While some disagree with the way this measure has been applied, a direct relationship between it and equivalent TV costs at a given institution is quite valid. In addition, it was decided to define benefit only in terms of the "incremental" number of students (actually student-contact-hours) served by the TV system, with no attempt to measure the effectiveness of the learning process (hundreds of studies already attest to the conclusion that students learn just as well (or better) by TV than in a live face-face environment). This "incremental" number of students includes students of all kinds: graduate and undergraduate, credit and non-credit, engineering and non-engineering. There appears to be a growing tendency to share on-campus courses by ITV with other than students taking them for credit. A number of ITV systems include an auditor category and a category of students who are tested and graded but not-for-credit. Further, there is a growing tendency to use these systems for business administration, management and special non-credit courses. Such expanded use of the ITV facilities can bring additional income combined with greater service to the community.

The Task Force avoided considering as "part of benefit" incremental income or "released time" to participating faculty. In some cases, such incremental income is already being derived but as yet it is insignificant. While it may be significant in the future, its inclusion at this time is not warranted. There are other "benefits" to both the institution and the faculty relating to participation in TV which were deliberately not included because, while real, they are intangible. Included in such benefits are "greater service to the community," and "better

* the ratio of total teaching payroll including faculty, lecturer, acting faculty, visitors, adjunct professors, teaching and laboratory assistants to student-credit-hours or student-contact-hours.

relations between the institution and the users of its product."

Cost is defined as the incremental cost to the university incurred due to the use of television, including amortized capital costs, annual operating costs and added instructional costs (if any). Clearly, the closer a TV system comes to recovering such costs or if it accrues a surplus, the more successful the operation will be.

The Task Force sent questionnaires to all institutions known to be involved with off-campus TV. These questionnaires were to be completed by both the institutions and by their participating user groups. After reviewing the information provided, the Task Force decided to present only a summary overview of all of the responses and to concentrate its detailed analysis on three mature major ITV systems, each of which have been operational for at least 5 years, those of Colorado State University, Stanford University and TAGER.

On these systems, the report provides a detailed description, operating data for 1972-1973, an analysis of these data and a comparative analysis with on-campus costs. One of the systems is used as an example to show the effect on energy conservation, the environment, safety and dollars relating to using telecommunications as an alternative to automotive transportation. Also included is a hypothetical treatment of four cases comparing video tape delivery systems with rf delivery systems. The report also presents a collation of industry responses to the Task Force questionnaires which primarily reflect attitudes rather than cost-effectiveness considerations.

II - UNIVERSITY ITV SYSTEMS

Based on the best information available to the Task Force as of Fall, 1973, Table 1 lists all operating University ITV systems. Included is a brief description of each system along with an indication of whether the institution involved responded to the Task Force questionnaire. Where a response was received, the information presented may be considered more reliable. The information is broken down by State and alphabetically within each State. Figure 1 shows the number of university ITV systems implemented each year since the first system in 1962.

A. University Responses

Table 2 tabulates responses received from universities to the Task Force questionnaire. The following summarizes those responses:

1. 12 out of 13 utilize TV classrooms.
2. 3 out of 13 utilize TV studios.
3. 10 out of 13 have students on-campus in all televised courses.
4. 3 out of 13 are developing special non-credit courses for television.
5. 13 out of 13 make faculty participation voluntary.

6.a 0 out of 13 compensate the faculty in dollars for TV teaching.

b 3 out of 13 compensate the faculty in released time for TV teaching.

c 3 out of 13 utilize residual benefits for non-credit off-

campus use of televised courses.
7. 0 out of 13 utilized televised courses provided by others.
8. 2 out of 13 re-use video taped courses on-campus.
9. 5 out of 13 use video tapes of courses to derive off-campus income.
10. 3 out of 13 derive income from leasing TV facilities to others.
11. 4 out of 13 participate in consortia with other institutions.
12. 2 out of 13 are interacting with cable TV systems.
13. 6 out of 13 utilize TV system during summer academic period(s).
14. 5 out of 13 utilize TV system during non-academic periods.
15. 9 out of 13 would recommend ITV involvement to others, 4 out of 13 did not respond, 0 out of 13 responded negatively.
16. 5 out of 13 utilize TV surcharges.
17. 7 out of 13 apply tuition income in justifying television involvement.
18. 1 out of 13 is accruing income in excess of incremental cost.

B. Industry Responses

Table 3 tabulates responses received from industry questionnaires relative to ITV. These responses may be summarized as follows:

1. Attitudes - Very positive on the part of top management, supervisors and participating employees.
2. Participation Factors - Very positive in recommending participation to others. Very positive as to ITV being vehicle for greater student participation and reaching senior people. Fifty-fifty in helping in recruitment and employee retention.
3. Work Commitments - Almost unanimous in allowing time off during day to participate. Very positive towards video tape for make-up and review of missed classes.
4. Course Selection Privileges - Very positive towards wanting them. Most claim they use them.
5. Talkback - Utilization highly variable from minimal to very much. Most think it important but almost 40% do not. Over half would still participate without it.
6. Credit, Degrees, Certificates - Preponderance in favor of some kind of "recognition." Heavily in favor of credit and degrees. Very favorable towards "certificates of completion."

III - COLORADO STATE UNIVERSITY (SURGE*) ITV SYSTEM

The CSU SURGE system is the largest, longest operating example of serving off-campus fully employed engineering students by video tape on essentially a state-wide basis. It can be used as a standard of comparison for other existing or proposed video tape delivery systems.

* Colorado State University Resources for Graduate Education.

A. Background Information**

Colorado has a concentration of technology based industries and government facilities situated along the eastern slope of the Rocky Mountains in a narrow, 160-mile strip extending from Fort Collins to Pueblo. To provide continuing education opportunities and graduate level course work for the professional employees of these organizations, the College of Engineering of CSU initiated Project Colorado SURGE in 1967. Complete MS degree programs are provided. An expanded program under SURGE leading to an MBA was initiated in 1972-73.

Course work is delivered in the form of video-taped classes with the same supporting materials as provided on campus. Every video tape is of a regular on campus course attended by on-campus students. The classes are held in regular classrooms equipped for TV (2,3,4). The lectures and student questions and discussion are recorded on the video tape. The tapes are packaged with class materials, assignments and examinations and delivered commercially to each user location. The off-campus classes usually view the tapes two days following the on-campus class. Over 80 percent of these viewings are during regular working hours. Tapes may be retained so that any person missing a class may see the tape at some later time. After being viewed, the tapes are returned to the campus, erased, then reused to record other classes.

SURGE students complete the same assignments, reports and examinations as on-campus students. Where laboratory or computer work is required, SURGE students use facilities of their employer. The inconvenience of limited library facilities is overcome by sending a single copy of reference articles to each location.

Faculty members teaching on SURGE are encouraged to make at least two visits per quarter to each industrial location for direct contact with students. Additional live interaction between faculty and students occurs in occasional telephone calls and more rarely by student visits to campus.

During the first six years of the SURGE program, 50 engineers of participating companies have been awarded MS degrees completely through the video tape program. Over 16,000 quarter hours of credit have been earned by other professionals without leaving their place of employment.

B. SURGE Participation

Table 4 is a summary of SURGE participation from inception of the system in the Fall, 1967 through the Summer, 1973. Included are the number of courses, the number of students and the number of participating organizations (remote locations). These data are plotted on Figure 2.

** Information contained in this report was derived from (2). Further information is contained in (3) and (4).

C. SURGE Capital Cost*

The following summarizes the capital cost of the TV related facilities devoted to the SURGE system:

1.	Studio Classrooms and Operator Consoles (3 total) Table 5 shows a breakdown of these costs.	$ 90,000
2.	Interconnect Between Classrooms and Master Control	3,500
3.	Master Recording Area (Master Control) They include 38 VTR's (no video tape), cabling, racks and audio and video switching. A breakdown of these costs is also shown in Table 5.	58,255
	Total Capital Cost	$151,755

4. Investment Cost in Video Tape

While video tape is amortized as an operating cost, it still requires a significant "front-end" investment. For example, if an average of 4.5 copies of 26 courses were made, it would required 117 tapes for each course hour. At 3 hours per week per course and assuming a 4 week supply of tape (before erasure and reuse of returned tapes) an investment in tape inventory might be required of:

Dollar in tape inventory = $20/tape x 26 courses x 3 hours/week/course x 4.5 copies/hour x 4 weeks = $ 28,080

D. SURGE Operating Costs

Operating costs of a video tape system are split between "dollars pe recording hour" and "dollars per delivered tape." The cost factors for the academic year 1972-1973 are used for the analysis. The following information is pertinent:

Total courses = 110
Total course-hours = 30 x 110 = 3,300
Total Section ** = 315
Total off-campus student-course-registrations = 1,277

1. Dollars Per Recording Hour

These costs are independent of the number of tapes made and include base operating costs and amortization of pertinent capital costs. Costs relating to VTR's and tape will be treated on a per tape basis. Space costs are not included because space used is usually not an incremental cost.

a. Table 6 lists base operating costs. From this Table we get:

* Do not treat these costs as current or necessarily representative of 1974 prices and requirements.
** A Section is a group of off-campus students meeting at a location and requiring a tape.

Base Operating Cost = $\frac{\$60,900}{3,300 \text{ course-hours}}$ = $18.45 per course-hour

b. The equipment to be amortized has a 10 year useful life and includes the sum of items in paragraphs C.1 and C.2. Assuming interest at 6% per year ($0.13587/dollar/year):

Capital Amortization Cost = $\frac{\$93,500 \times \$0.13587/\text{year}}{3300 \text{ course-hours/year}}$ = $3.85/course-hour

c. Total Operating Cost/course-hour = $18.45 + 3.85 = $22.30/course-hour

2. Dollars per Delivered Tape

"Dollars per delivered tape" is comprised of the sum of tape amortization cost, VTR amortization cost, (3 year useful life) tape handling cost, tape delivery cost, instructional support cost and certain overhead costs. These are outlined below:

a. Tape Cost/Delivered Tape = $\frac{\$20/\text{hour (purchase price)}}{100 \text{ uses}}$ = $0.20/delivered tape

b. VTR Cost/Delivered Tape = $\frac{\$36,845 \times \$0.37411}{315 \text{ section} \times 30 \text{ tapes/section}}$ = $1.46/delivered tape
From Table 5 (6%/3 years)

c. Other Recording Facilities Cost/Delivered Tape = $\frac{\$21,410 \times 0.13587}{315 \text{ section} \times 30 \text{ tapes/section}}$ = $0.31/delivered tape
From Table 5 (6%/10 years)

d. Tape Handling Cost = $0.50/delivered tape (estimated by CSU)

e. Tape Delivery Cost = $1.00/delivered tape (estimated by CSU)

f. Faculty Travel Allowance - $1.25/delivered tape (estimated by CSU) to visit students

g. Secretarial/supplies/phone = $0.30/delivered tape (estimated by CSU)

h. Instructional Support = $1.00 x $\frac{1,277}{315 \text{ sections}}$ = $4.05/delivered tape (estimated at $1/off-campus student/section)

i. Total Dollars/delivered tape = (sum of a thru h) = $9.07

E. SURGE Cost-Effectiveness (Instruction Cost Index)

1. From the previous analysis of costs, the total costs for 1972-1973 are as follows:

Total Operating Cost = $22.30/hour x 3,300 hours = $ 73,590.
Total Cost for Delivered Tape = $9.07/delivered tape x 315 sections x 30 tapes/section = 85,712.

Total 1972 - 1973 cost = $159,302.

2. So, cost/quarter-credit-hour = $\frac{\$159,302.}{3 \times 1277 \text{ quarter-credit-hours}}$ = $41.58

and cost/student-contact-hour = $\frac{\$41.58}{10}$ = $4.16 = instruction cost index)

3. From (2)., related on-campus costs at CSU for 1972-1973 are:

Instruction cost/student-contact-hour (graduate engineering) = instruction cost index = $ 6.50

This instruction cost index can be derived from (1) by assuming an escalation rate of costs of 5%/year for 7 years. Table 7 shows these indices for different classes of institutions. CSU is assumed to fall in the Group II H category.

4. The economic viability of the TV system relates to the sharing of on-campus instruction with off-campus students, thereby minimizing incremental instructional costs. If one assumes that the on-campus instruction is already paid for and that off-campus students would not participate without TV, then it is possible to compare the cost of educating the TV students via the TV system with the cost of teaching equivalent students on-campus.

From the above it can be concluded that the CSU SURGE program serves off-campus graduate degree seeking students in Colorado at:

$\frac{4.16}{6.50}$ = 64% of the cost of serving on-campus graduate students

Therefore, the TV system is an economically viable alternative to on-campus instruction, even with zero cost recovery. The situation is really better than this because along with the off-campus students comes <u>incremental</u> tuition income of: (CSU makes no surcharges)

1277 students x 3 credit-hours/student x $23/credit-hour = $88,113.

If we subtract this from the annual cost of SURGE, we obtain for <u>net</u> SURGE cost:

159,302 - 88,113 = $71,189

This leads to a net off-campus cost/contact-hour of:

$\frac{71,189}{3 \times 1277 \times 10}$ = $1.86

and this leads to a comparative cost relative to doing the

same job on-campus of:

$\frac{1.86}{6.50} = 29\%$

The alternatives to the TV system are either to create new schools and faculties, or to service the need by transporting existing faculty or to do nothing at all. The first two alternatives have proven to be economically untenable. The third alternative may be socially unacceptable.

It can, therefore, be concluded that if the state sees its obligation as providing educational services to all eligible students in the state, then the cost of accomplishing part of this objective by television can be significantly lower than equivalent education on campus, even if none of these costs are offset by income.

F. Cost of Facilities at Participating Organizations

The cost of off-campus facilities were not included in the previous cost calculations as they are paid by the organizations participating in the CSU SURGE system. Nevertheless, such cost information is pertinent and is presented in Table 8. It is easy to conclude from this that in a "video tape delivery" system, off-campus facilities costs are linearly related to the number of classrooms (for simultaneous viewing), independent of the number of geographic locations of the organizations.

IV - STANFORD UNIVERSITY ITV SYSTEM

The Stanford University ITV system has been operational for five (5) years. It is the first to be funded entirely by participating organizations whose students utilize the "product" of the system. It offers a diversified curriculum responsive to the educational needs of the surrounding industrial community. Among all operating ITV systems, Stanford offers the greatest diversity and number of courses that relate to the full spectrum of industrial interests, covering the range of engineering, science, business, management, supervision and training such as rapid reading, effective listening and secretarial skills. Several other institutions utilize the TV facilities of Stanford to reach the same participating organizations. Stanford incorporates a video tape mode to supplement its live interactive mode and its instructors are already deriving income from off-campus non-credit use of recorded materials. Stanford is a mature system which is expanding and is now accruing a surplus of income over incremental costs. In the early years it operated at a deficit. Stanford represents what can be done in matching the interests and needs of a university to the interests and needs of the industrial/governmental community. A detailed description of the Stanford ITV system is available (5).

A. Background Information

Stanford University is surrounded by a large number of technology based industries located throughout the San Francisco Bay Area. Starting in 1953, the School of Engineering initiated an "Honors Coopera-

tive Program" (HCP) wherein it opened its on-campus classes during the regular academic day to fully-employed part-time matriculated students. Organizations desiring to have students participate in the HCP are required to pay matching fees, approximately equal to tuition in order to cover the full costs of instruction. This HCP on-campus program has been very popular and is highly successful. The TV system was initiated to overcome the geographical limitations of the on-campus program, to broaden participation in regular Stanford courses to allow for auditor and non-matriculated student participation, to allow for serving a broader spectrum of industry educational needs, while, at the same time, providing economic benefit to the university.

B. Instructional TV in Operation

Stanford concentrates on courses at the master's degree level. By utilizing only Stanford's regular teaching hours (no evening program) of 8 A.M. to noon and 1-5 P.M., it is possible to televise 180 three-quarter-unit courses during a calendar year. This represents more than 5000 hours of instruction per year. Since the typical master's degree program in engineering requires only about 15 courses, the four-channel system capacity allows a diverse course representation from all graduate engineering departments as well as from related sciences.

Network member organizations are permitted to make "off the air" video tapes of Stanford lectures for make up of missed classes or for course review.

It was realized that the television facility could provide additional educational benefits beyond the part-time degree-oriented program for matriculated students. One addition was a "non-registered option," (nro) which permits non-matriculated industry graduate students to take televised courses. Such students are tested and graded to the same standards as regular students. Auditors are permitted in the remote TV classrooms at reduced fees. They receive no testing or grading. Selected seminars of interest to the network members are televised and are available without fees.

The system is available at noon and in the early mornings and evenings when Stanford courses are not being held. This affords an opportunity for additional education of all kinds. A separate non-profit corporation, the Association for Continuing Education (ACE), has been established to provide such programming. Its membership comprises the organizations which participate in the Stanford ITV Network. ACE courses are directly responsive to the needs of its sponsors. It offers non-credit courses ranging widely in interest and it offers an MBA degree program, under the auspices of Golden Gate University; the Foundation Program for the MBA degree, under the auspices of the College of Notre Dame; graduate courses for credit in Cybernetics Systems Engineering, under the auspices of San Jose State University; non-credit courses from the U.C. Extension Division and special courses such as put on by Xerox Learning Systems. The added dimension of ACE is a vital ingredient in the financial viability and acceptance by industry of the Stanford ITV Network.

C. Stanford Network Participation

Table 9 is a summary of Stanford Network participation from inception of the ITV system in the Spring of 1969. Included are the number of courses, the number of students in each student category, and the number of participating organizations. These data are plotted in Figure 3 and clearly show the growth trend in courses, students and industrial participation.

D. Stanford Capital Costs*

The capital costs of the facilities devoted to the Stanford ITV Network are tabulated on Table 10. They approximate $615,000. While Stanford does record a number of its courses on video tape, this activity is an add-on which is not fundamental to the ITV system operation. It is conducted on the basis of recovering all costs plus a surplus. Therefore, capital costs associated with this portion of the system have not been included in the estimates on Table 10.

Table 10 also includes, for the sake of completeness, estimated costs of live ITV systems with fewer channels (6). The cost of the 2 channel system shown correlates closely with that of the University of Minnesota ITV system which was completed in 1971. Great care must be taken in comparing ITV system costs. For example, a great deal more money was spent on classroom facilities at some institutions compared to others for the express purpose of creating an attractive teaching environment for the faculty.

Of the $615,000 in capital costs shown $166,000 is applicable to the RF (radio frequency) portion of the facilities and $215,000 to the on-campus video/audio related facilities. Of the remaining $234,000, probably 70% or $164,000 is also allocable to the RF system. Therefore, the estimated total cost of the RF system is:

1. Total RF system cost = $330,000 and
2. Total Video/Audio system cost = $285,000.

E. Stanford Operating Costs

Operating costs of the Stanford ITV system are also tabulated on Table 10. They total approximately $120,000 annually for approximately 6,000 hours of televised courses. The resultant cost of $20 per hour is typical of what can be expected in an efficiently run live interactive TV system (an approximately equivalent cost is the $18.45/course-hour for CSU from Section III.E.1).

The above cost does not include amortization of capital equipment. This equipment has a 10 year useful life and, when amortized, adds to operating cost as follows:

1. RF system cost = $\frac{\$330,000 \times \$0.13587/\text{year}}{6,000 \text{ TV hours/year}}$ = $7.47/hour
= $44,820/year

* Do not treat these costs as current or necessarily representative of 1974 prices and requirements.

2. Video/audio system cost = $\frac{\$285,000 \times \$0.13587/\text{year}}{6,000 \text{ TV hours/year}}$ = $ 6.45/hour

$38,700/year

3. So <u>total</u> operating cost is:
$20.00 + 7.47 + 6.45 = $33.92/operating hour

F. <u>Stanford Cost-Effectiveness (Instruction Cost Index)</u>

1. From the previous analysis, the total cost for 1972-1973 is:
$33.92 x 6,000 hours = $203,520.

2. If we consider Stanford courses only, the cost reduces to:
$203,520 - (118,643 - 113,280) = $198,157

Where $118,643 = total annual operating cost
113,280 = annual operating cost without ACE

3. In 1972-1973, From Table 9, there were 2,029 student course registrations in Stanford courses representing 2,029 x 3 = 6,087 quarter-credit-hours. Therefore, the cost per credit hour for Stanford courses only is:

Cost/quarter-credit-hour = $\frac{\$198,157}{6087}$ = $32.55 and

Cost/student-contact-hour = $3.26 = instruction cost index

4. A more realistic appraisal of costs is to consider all costs and all students served. Using these numbers:

Cost/quarter-credit-hour = $\frac{203,520}{4,199 \times 3}$ = $16.16

where 4,199 is the total of all students, from Table 9, not just Stanford students.

5. From Table 7, in 1965-66, the Stanford "instruction cost index" was $46 per semester credit hour. Updated at an estimated increase per year of 5% and normalizing to contact hours, one obtains:

1972-1973 estimated Stanford ICI = $6.47/student-contact-hour

Utilizing the result from F-3 above and <u>not</u> including cost recovery, it is clear that Stanford is serving its off-campus TV students at a cost of:

$\frac{3.26}{6.47}$ = 50% of on-campus costs

The same qualifying statements made in Section E of the CSU analysis pertain here.

6. The facts are actually much better than this. The above calculations have ignored cost recovery. In the case of a private institution such as Stanford, cost recovery is essential. The data on cost recovery are shown on Table 11 (Stanford charged tuition of $60, a matching fee of $50 and a TV surcharge of $20, all per quarter-credit-hour). From these data one can conclude

the following:

a. Minimum surplus accrued by Stanford over operating costs is:

$$\$137,720 - 118,643 = \$19,077$$

where $137,720 includes all income except HCP matching fees and HCP tuition and $118,643 is annual operating cost.

b. Reasonable estimate of surplus accrued by Stanford over operating costs would include that portion of HCP matching fee allocable to students who would not participate without TV. This is estimated at:

$$\$19,077 + \frac{\$78,700 \times 0.45}{0.60} = \$19,077 + 59,025 = \$78,102$$

where $78,700 represents 60% of HCP matching fees received from all HCP students and 45% is the estimated percentage of all HCP students who would not have participated without TV.

c. Maximum estimate of surplus accrued by Stanford over operating costs would also include the tuition income from the students in 6-b above. This is estimated at:

$$\$78,102 + \frac{\$94,440 \times 0.45}{0.6} = \$78,102 + 70,830 = \$148,932$$

d. One may wonder why capital amortization costs were not included in the above in estimating surpluses. The reason is that Stanford recovers these costs from capital contributions. If these costs were to be considered, the surpluses shown would be reduced by: 6,000 x $13.926/dollars/operating hour/year (from paragraph F) = $83,556/year. Under these conditions, Stanford would clearly need to count all TV related income to justify its ITV activities.

7. One of the pertinent facts worth realizing results from a look at what happens to Stanford's income if they did not have ACE and if they had no special student categories such as NRO's and auditors.

a. From Table 11, the incremental TV income drops to $31,480.

b. From Table 10, TV operating costs remain equal to $113,280. There is then a net loss to Stanford of:

$$(113,280) + 31,480 = (\$82,000)$$

c. Applying HCP matching income reduces this loss to:

$$(82,000) + 59,025 = (\$14,103)$$

d. Applying tuition income results in a gain of:

$$(14,103) + 70,830 = \$56,727$$

e. Many organizations are participating primarily because of the auditor, NRO and ACE related features of the ITV system. If these features did not exist, a significantly different picture would be apparent. For example, of the 4,199 student course registrations in 1972-1973, only 562 or 13% are matriculated Stanford students. One can conclude therefore that the Stanford School of Engineering ITV Network is economically viable as a direct result of the totality of

its educational services to industry, not just those related to degree seeking students.

G. Cost of Facilities at Participating Organizations

In a live ITV system such as Stanford's, each geographic location must have "head-end" equipment for receiving the TV transmission and for converting the signal to be viewed by a standard VHF TV receiver. The costs associated with off-campus facilities are shown in Table 12. In this case, costs are not linearly related as the head-end equipment is broad-band and capable of handling at least 4 simultaneous channels of transmission. In comparing these costs with the costs associated with a video tape delivery system (Table 8), it can be seen that costs favor the video tape system for one classroom, are essentially equal for two classrooms and then favor the RF delivery system for three or more classrooms. However, in the case of the RF system, each separate geographic location requires its own head-end equipment so that cost comparisons must take this into account.

V - TAGER ITV SYSTEM (The Association for Graduate Education and Research of North Texas)

The TAGER ITV system has been operational for seven (7) years. It, along with the Genesys system in Florida, was a prototype for the Stanford ITV system. Nine institutions (SMU, TCU, U. of Dallas, U. of Texas-Dallas, Austin College, Bishop College, Texas Wesleyan College, Dallas Baptist College, Southwestern Medical School) and ten (10) industrial organizations are linked into the system. Like Stanford and CSU, it programs both engineering and business courses, primarily at the graduate level. It does not include a non-credit continuing education program such as provided by ACE in the Stanford system. Programming hours are 8 A.M. - 10 P.M. A detailed description of TAGER is available (7).

A. Background Information

TAGER was formed in 1965 as a consortium of universities and colleges "to further the abilities of its participating institutions in meeting regional and national needs for more and better-prepared engineers, scientists and other scholars." The "microwave backbone" of the system was funded by a gift. Institutions funded their own on-campus originating facilities and participating companies and institutions funded receiving classrooms. Some additional funding was provided by NSF. Total system costs as of 1970 approximated 2.5 million dollars. Audio talk-back is available by means of telephone lines. TAGER represents what can be done on a large scale in important aspects of cooperation among institutions of higher education.

B. Cost and Participation Data

Table 13 presents Basic Unit Costs and Unit Factors as received from SMU. All amortization of capital cost data presented assume a 7 year life and 7% annual inflation. In order to be con-

sistent with assumptions made for both CSU and Stanford, the data below will assume a 10 year useful life and interest at 6%/year. Also, since receiving classrooms were not included in the CSU and Stanford analysis, they will not be included here.

1. Total Capital Costs

12 studio-classrooms at $50,000. each =	$ 600,000.
Receiving classrooms (18 at schools/26 industry) =	-
42 microwave chanel hops	1,680,000.
6 ITFS channels	60,000.
Total	$2,340,000.

2. Operating Costs

a. Annual operating costs are:

Studio operations (160 x 300) =	$ 48,000.
System operations (160 x 600) =	96,000.
System maintenance =	32,000.
System overhead =	22,000.
Sub-total	$ 198,000.

or $\frac{198,000}{160 \text{ courses} \times 45 \text{ hours/course}}$ = $27.50/course-hour

(This compares to $20. for Stanford and $18.45 for CSU)

b. Annual amortization costs are:

$2,340,000 x 0.13587/year = $ 317,936.

c. so total annual operating costs are:

$198,000 + $317,936 = $ 515,936.

d. Cost/televised hour/year = $\frac{\$515,936}{160 \text{ courses} \times 45 \text{ hours/course}}$ = $ 71.66

C. SMU Cost-Effectiveness (Instruction Cost Index)

From the above, assuming all courses represent 3 semester-hours (45 contact-hours) we get:

1. Total semester hours/year = 3 x 1,695 student course registrations/year = 5,085.
2. Cost/semester-credit-hour = $\frac{\$515,936}{5,085}$ = $ 101.
3. Cost/student-contact-hour = $\frac{\$101}{15 \text{ hours/credit hour}}$ = $6.73
   (Instruction cost index)
4. Income received from off-campus students = $1,695 x $300 = $ 508,500.
   (Tuition is $80/semester-credit-hour and TV surcharge is $20)
5. Net cost = $515,936 - 508,500 = $ 7,436.

6. so net instruction cost index = $\frac{\$7,436}{5,085 \times 15} = \$0.10$

7. Referring to Table 7, it is difficult to decide which category of institution would describe SMU. Nevertheless, the ICI of $6.73 (from C-3 above) is clearly in the range of typical on-campus costs. With cost recovery, the SMU ITV ICI (C-6 above) is very low, even though TAGER is a very large, complicated and costly system.

D. Cost of Facilities at Participating Organizations

For the ITFS portion of the TAGER system, the cost data shown on Table 12 and the comments in Section IV-G are applicable. However, many organizations in the TAGER system are (were) served directly by 12 GHz microwave and the costs for such receiving equipment is much higher. If we take the present capital cost of 44 TAGER classrooms, which approximates $220,000, we obtain an average cost/classroom of $5,000. This agrees with the numbers given in Table 13. It is this large cost of receiving classrooms (plus line-sight microwave transmission costs) which lead TAGER into incorporating ITFS into their system where wide-area transmission is feasible and to continue to rely on 12 GHz microwave primarily for point-point transmission.

VI - IMPACT ON ENERGY CONSERVATION, THE ENVIRONMENT, SAFETY AND DOLLARS

There has often been expressed a strong visceral feeling that an ITV system has benefits and cost-savings, which are real and measurable, other than those treated in Sections III, IV and V. This Section will treat such benefits and cost savings and use the data on the Stanford ITV system given in Section IV as an example. From the Stanford data for 1972-1973:

A. Facts

1. Number of student-course registrations = 4,200
2. Number of student-contact-hours = 120,000

B. Assumptions

1. Average round trip distance to campus = 12 miles
2. Average miles/gallon of gas = 12 (IRS tax tables)
3. Automotive transportation cost = 12¢/mile
4. Average travel and parking time = 1 1/4 hours
5. Average salary of students = $7/hour
6. Average automotive injuries = 2.06/million-vehicle-miles (4 lane undivided highway)
7. Average pollutants/mile (8) = 45 grams (using existing emission standards)
8. All students are participating by TV instead of coming to campus.
9. Each student would spend an average of 1 1/2 hours in class if he came to campus.

C. Resultant Savings Per Year

From the above we get:

1. Number of round-trips to campus saved = $\frac{120,000}{1.5}$ = 80,000
2. Transportation cost savings - 80,000 trips x 12 miles/trip x $0.12/mile = $115,200
3. Mileage saved = 80,000 trips x 12 miles/trip = 960,000
4. Gallons of gasoline saved = $\frac{80,000 \text{ trips} \times 12 \text{ miles/trip}}{12 \text{ miles/gallon}}$ = 80,000
5. Pounds of pollutants saved = $\frac{960,000 \text{ miles} \times 45 \text{ grams/mile}}{454 \text{ grams/pound}}$ = 96,000
6. Injuries saved = 960,000 miles x 2.06 injuries/million-vehicle-miles = 2
7. Cost of time saved = 80,000 trips x 1 1/4 hours/trip x $7/hour = $700,000

It is apparent that the above numbers are significant, even for a local area system such as Stanford's. Also, it is clear that society as a whole and individuals can, by the use of ITV, benefit significantly in safety, environmental conditions, traffic congestion and dollars, costs not counted in the previous analyses which were restricted to university costs. If one extrapolates these numbers to the approximately 2 million engineers employed in the USA, plus other professionals who do or should participate in continuing education, the results become very large indeed.

The use of telecommunications to overcome geography, transportation costs, time and inconvenience is not new. Consider, for example, what would result if we had no telephone system. What may be new is a realization of how large these numbers can be.

VII - COST COMPARISONS OF LIVE ITV SYSTEMS WITH VIDEO TAPE SYSTEMS

Any institution which is considering reaching students off-campus, either where they work or where they live, must carefully consider all pertinent technical delivery systems (6). In making comparisons, the costs of originating classrooms and associated facilities can be assumed to be the same in all systems. The things which will differ are the cost of "delivery" and the cost of receiving facilities.

Except for 12 GHz receiving facilities, which are seldom used, the cost of one kind of receiving facility is not very different than another and those costs are rarely paid by the university. For this reason, receiving facility costs are usually not pertinent to the decision process.

Talkback costs can also be eliminated in making cost-comparisons. A given type of talkback system, whether by phone or radio, can be associated with either a live system or a video tape system. If talkback is considered essential, it must be considered in either case. Although the research shows little or no evidence that talkback improves the learning process, the question continues as to whether talkback is essential. After four years of experience, Stanford no longer requires talkback as a precedent for participation. It is now optional. However, there are certain non-technical courses where it is used extensively. Many schools, faculties and students

will continue to view the existence of a talkback system as a vital ingredient in a complete educational system.

If there is no talkback, why have a live system? There is no way of knowing whether a program is live or taped by watching the TV screen. There will be, however, circumstances in certain geographic/industrial areas where it would be less expensive to broadcast single tapes than to deliver and handle large numbers of tape copies to multiple locations. There are also faculty costs to consider as well as faculty and student attitudes.

Ignoring all criteria but the cost in dollars, is there an optimum delivery system for every institution which wishes to reach off-campus students by TV? The answer to this is yes! However, to configure such a system requires the institution to clearly define what it wants to use the system for; where it wants the system to reach geographically; whether it wants to reach students at home, at work and/or in special gathering places (schools, store fronts, etc.); whether it is willing to accept a financial risk; whether it has faculty, administration, and trustees (and maybe State) support; how it will manage and operate the system; how it will recover its costs; how it will come by "front-end" money to create the system; how it will handle credit, degrees, advising, testing, and grading; to what extent it will share facilities with others; how it will relate to other institutions; and who will "carry the ball" for the institution.

No detailed cost comparison numbers will be presented here. However, it is useful to consider some hypothetical cases which give an insight into some of the factors affecting choice of delivery system:

Case 1. Start with the Stanford ITV "rf delivery system" cost of $44,820/year (Section IV-E). This is the cost of reaching 30 companies with 6,000 hours of programming (1972-73). Now ask the question - using "tape delivery" system costs, what would it have cost Stanford to do the same job by video tape?

a. From Section III.E.2.h, we have: dollars/delivered tape = $9.07.

b. Using CSU numbers for sections and courses and extrapolating to the Stanford situation we get:

$$\frac{315 \text{ sections}}{110 \text{ courses}} = 2.86 \text{ sections/course}$$

c. So total cost for delivered tapes is:

2.86 sections/course x 200 courses/year x 30 tapes/section x $9.07/tape = $155,641.

d. Therefore, for this example we get:

$$\frac{\text{rf delivery cost}}{\text{video tape delivery cost}} = \frac{44,820}{155,641} = 29\%$$

Case 2. This time start with the TAGER ITV system "rf delivery system" cost. From Section V.B.1 this is:

a. $1,740,000 x 0.13587/year = $236,414/year

b. Again, using CSU section/course data and extrapolating to TAGER we get:

Total cost for delivered tapes = 2.86 x 160 courses/year x 45 tapes/section x $9.07/tape = $186,769

c. Therefore, for this example:

$$\frac{\text{rf delivery cost}}{\text{video tape delivery cost}} = \frac{236,414}{186,769} = 127\%$$

Case 3. Let's go back to the Stanford example and keep everything the same except assume the participating organizations are spread out as in the TAGER system and that the "rf delivery system" cost would therefore approximate TAGER's (1,740,000) instead of the present cost ($330,000 from Section IV-D). Then we get:

$$\frac{\text{rf delivery cost}}{\text{video tape delivery cost}} = 29\% \times \frac{1,740}{330} = 153\%$$

Clearly, in this case, a change from a relatively tightly bunched group of participants (40 miles radius) to a more geographically dispersed distribution radically changes the choice of which system to use.

Case 4. In this last case, let's again use the Stanford system as an example and see what happens if we reduce the level of programming and the level of participation in the courses, i.e., the equivalent of reaching fewer organizations and fewer students. Let's assume that only 100 courses are programmed, instead of 200 and that, on the average, there is only one section per course. Then we get:

$$\frac{\text{rf delivery cost}}{\text{video tape delivery cost} \times \frac{100}{200} \times \frac{1}{2.86}} = 29\% \times 2 \times 2.86 = 166\%$$

Case 4 is a perfect example of the need for an institution doing a thorough job of planning. If Stanford had guessed wrong at the beginning and had assumed too little participation, it might have chosen a video tape delivery system and Stanford would now be incurring delivery system costs almost four times present costs. On the other hand, if Stanford was overly optimistic and had over-built compared to the need, they might be paying a delivery cost premium of 166%. What in fact Stanford did was to start with two channels and build the second two only after it became clear that the participation pattern warranted expansion.

In summary, the choice between a video tape delivery system and an rf delivery system can be made by comparing only costs of delivery and ignoring on-campus or off-campus classroom costs and talkback. Almost always, where rf delivery is the choice, a supplemental video tape system to handle more remote students is worth considering. If the number of participating organizations is small or if the number is large but is widely dispersed geographically, the

choice will tend towards video tape. Conversely, if the number of organizations is large and within potential line of sight of a broadcast system, the choice will tend towards an rf system.

VIII - CONCLUSIONS

A. Most universities that are operating ITV systems and most organizations participating in such systems appear to be pleased with their involvement and would recommend it to others, subject to certain qualifications.

B. Only one university is at present fully recovering the incremental costs of its television delivery system. This favorable situation is the result of at least six factors:

1. The university is located in the midst of an unusually large number of high technology companies.
2. The system has been in operation for about five years and has grown considerably since its inception.
3. In addition to engineering courses for credit leading to an MS degree, the ITV system offers an MBA degree program along with the Foundation course program for the MBA.
4. Additional income is derived from regular credit courses by allowing industry employees not seeking degrees to take the same courses at reduced fees.
5. The television system provides a great diversity of non-credit courses outside of engineering that appeal to industry. In some cases, companies have joined the system primarily because of the availability of these non-engineering continuing education courses, some of which are at the level of training.
6. Effective use, with commensurate income, is made of the facilities, with programming on all 4 channels averaging approximately 8 hours per day, 5 days per week during the academic year and a significant summer schedule.

C. It is possible to serve off-campus students by TV at costs lower than those taught on campus in the usual way. For state-supported institutions, even if all incremental TV related costs are not recovered, this fact may be sufficient justification for establishment of a TV network.

D. RF delivery systems, despite their higher capital costs, can be less costly than video tape delivery systems. As the number of participating locations, courses and students grows within a given geographic area reachable by an RF delivery system, the advantage of "RF" over "video tape" grows. Conversely, if the number of participants are few, or as the geography to be covered expands, "video tape" can become less costly than "RF." Cost trade-off studies and risk analysis are essential precursors to embarking on an ITV system involvement.

E. Significant benefits in energy consumption, environmental impact, safety and cost can be achieved by institutions utilizing television to "deliver" education to people instead of using automobiles to deliver people to institutions.

F. TV need not be viewed as an "educational technology." Rather, it can be viewed as a means of overcoming geography; of possibly avoiding the creation, at university or state expense, of costly new buildings, classrooms and faculties.

IX - GENERAL OBSERVATIONS AND RECOMMENDATIONS

Universities considering establishment of an ITV system should carefully analyze the academic, technological and economic aspects of such an involvement before proceeding. The following considerations are relevant and important.

A. What audience is to be served? In what academic disciplines? Is the objective to better serve part-time students seeking degrees; to expand enrollment of such students; to provide improved continuing education and retraining services; or simply to establish closer cooperation with the community, enabling, for example, the sharing of seminar speakers? Is an additional objective to reach other schools for the exchange of courses? Or is it the intention to develop a combination of such uses?

B. Where are the students located? Are they all local, or are they state-wide, nation-wide or even world-wide?

C. What is the potential contribution of the foregoing applications in producing income to offset the incremental cost associated with the television delivery system? What is the nature of the accounting that will be used? Can, for example, the tuition from students who would not have taken courses had television not been available be credited against operating expenses? Can it be credited to departments or schools or will it revert to the general fund? If additional income is produced by allowing auditors and non-degree or non-registered students, or by collecting tuition surcharges, how will this money be distributed? Where are the incentives for the faculty? If there will be an initial operating deficit, how long is the university prepared to absorb it? Is the anticipated growth of the system realistic in terms of what it can offer potential users? Will there be a television surcharge? How much will the traffic bear?

D. If taking courses for credit over television costs the part-time student or his employer more than if he came to campus, are the university's offerings, as compared to those of competitive schools, in sufficient demand to sustain the additional cost? What are the reimbursement policies of organizations in the area? Will these organizations pay a television surcharge? If not, are the students prepared to pay as an offset to the costs of driving and the time and effort saved?

E. Are there enough potential participants to produce the level of credit and non-credit enrollments needed to sustain the system? Are the university's programs now servicing employed students mainly during the day or in the evening? (Employers of part-time students who presently participate in day-time classes can better justify television cost savings because of

lost work time than can those of evening students.)

F. Has the university accurately determined client organizations' needs for courses over television? What should be the mix of disciplines, levels and of credit versus non-credit continuing education and training courses? Is this mix an important factor in an organization's decision to join the system?

G. What is the nature of the industrial/government environment? -- Are there urban concentrations or extended rural deployment? What kind of system, video-tape or rf delivery, or both, appears better suited to the area? If an rf delivery system is installed, might the interests and needs of companies beyond its range require supplemental video tape delivery?

H. Does it make sense to "go it alone" or attempt to service the need by an ITV consortium of institutions. Will there be exchange of credit allowed? How will costs and income be shared? Who will manage and operate the system?

I. For either a video tape or rf system, what will be the nature of the interaction? Whether it be by traveling advisors, telephone (live or delayed) or rf, what will be its need and acceptability and what will it cost?

J. What is the attitude of the faculty toward television? Will they support it? Will they require additional recompense or reduced teaching loads? (If so, such costs must be factored in). What are policies on taping, replaying of tapes and residuals?

K. What are the prospects for making use of the system on weekends, between academic periods, and during the summer to increase income? Can the Engineering School alone support an economically viable system, or must it also include business administration and management? What about Medicine, Law, Education and other schools with potential uses of the system? Where, when and how, will they be accommodated?

L. Will there be any residence requirement, or can students earn a degree entirely by TV?

M. Will television be used as a delivery system of on-campus classes or will there be TV production type costs involved?

N. Will video taping for make-up and review be allowed at remote sites? Under what ground rules?

O. How will the ITV system be financed? What are the risks? Where will the initial investment come from?

The above summary will hopefully lead any institution contemplating involvement in ITV to do a very careful job of analysis and planning so that they are fully aware of the potential risks/rewards inherent in such an activity.

X - ACKNOWLEDGEMENTS

The Task Force expresses its great appreciation to all of those institutions and their participating user groups which cooperated in making this report possible. Filling out questionnaires is both time consuming and distasteful. But, as usual, the efforts of some will be of benefit to all. The Task Force hopes that this report will be sufficiently informative as to make the efforts expended worthwhile.

Clearly, not all of the information received from respondents was used in the report. However, it was all valuable and the details will be kept available for possible future use.

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(7) "Southern Methodist University and Industry: Electronic Partners," Chas. R. Vail and Peter E. Van't Scot, Educational/Instructional Broadcasting, Nov. 1969. See also TAGER brochure dated October 1970.

(8) "Automobile Emissions Abatement and Fuels Policy," Robert K. Prud'-homme, American Scientist, Vol. 62, March-April 1974

STATE	INSTITUTION	Responded to Task Force Questionnaire: Yes	No
ARIZONA	University of Arizona Video tape system - 1 classroom/20 courses/9 remote sites/300 total students/35 registered students. (In 1973-74 will have 2 classrooms/22 courses)	x	
CALIFORNIA	University of California (Davis) Has 2-way interactive TV (1 channel each way) by microwave with 1 remote location) plus 1 channel ITFS		x
	University of Southern California 4 channel live ITFS system - 4 classrooms/1 auditorium/1 master control/66 courses/176 students (12 receiving locations in 1973-74)	x	
	Stanford University 4 channel live ITFS system - 4 classrooms/1 auditorium/1 master control/214 courses/4,199 student course registrations (36 participating organizations in 1973-74)	x	
COLORADO	Colorado State University Video cassette system - 3 classrooms/1 master control/93 courses/1,127 student course registrations/34 participating organizations	x	
	University of Colorado Video tape system - 1 classroom - also 1 ITFS channel		x
FLORIDA	University of Florida The original GENESYS system linked Gainesville campus (by telephone company microwave) with Daytona Beach, Orlando, Cape Kennedy, West Palm Beach and Boca Raton. Data made available is dated August 1971 and is no longer pertinent. Fall off in student participation and high fixed costs dictated a change in the utilization of Genesys	x	
ILLINOIS	Bradley System primarily serves elementary schools. Has access to 1 UHF-TV channel, 4 ITFS channels, 1 FM station and accesses 1 CATV head-end	x	

NOTE:
1. All data given are for the 1972-73 academic years
2. All systems are primarily black and white, not color
3. Most systems use overhead and rear cameras. Some use third camera to look at students. Some use only one camera.

UNIVERSITY ITV SYSTEMS
TABLE 1

STATE	INSTITUTION	Responded to Task Force Questionnaire Yes	No
INDIANA	Indiana Higher Education Television System (IHETS) Services Ball State University, Indiana State University, Indiana University and Purdue University. IHETS is state-wide system with telephone company microwave backbone and several ITFS head-ends in different cities		x
	Purdue University Part of IHETS. 1 classroom/4 courses/38 student course registrations/5 remote participating groups.	x	
IOWA	Iowa State University Video tape system. 3 classrooms/19 remote locations/33 courses/309 student course registrations. State-wide service	x	
MICHIGAN	University of Michigan 2 classrooms/2 telephone company microwave channels to Detroit, 2 ITFS channels in Detroit		x
MINNESOTA	University of Minnesota 2 classrooms/2 ITFS channels/1 master control/relays 90 miles to Rochester/57 courses/470 student course registrations/8 remote locations		x
NEW YORK	Cornell University 2 classrooms/3 remote locations/video cassette system		x
	Rochester Institute of Technology Video tape system. Single studio production/5 remote locations/205 student course registrations	x	
	State University of New York at Buffalo 1 classroom/1 ITFS channel/ties in with SUNY microwave network		x
OHIO	Case Western Reserve 2 classrooms/2 ITFS channels/7 remote sites/17 courses		x
	Ohio State University 1 telephone company microwave to 1 location		x
OKLAHOMA	Oklahoma Higher Education TV System 2 channels. Links University of Oklahoma, University of Tulsa, Oklahoma State University and University of Oklahoma Medical School and industry. 4 remote locations/72 courses/microwave interconnects + ITFS in 3 locations.		x

Table 1 - continued

STATE	INSTITUTION	Responded to Task Force Questionnaire Yes	No
PENNSYLVANIA	University of Pennsylvania 2 classrooms/2 ITFS channels/7 remote locations/367 student course registrations/15 courses	x	
RHODE ISLAND	University of Rhode Island 1 classroom/1 microwave chanel/1 remote location/9 courses/29 student course registrations	x	
SOUTH CAROLINA	University of South Carolina Video tape + ETV/15 remote sites/11 courses per semester/103 student course registrations per semester	x	
TENNESSEE	University of Tennessee Video tape system. 1 classroom/6 remote locations/20 courses per quarter		x
TEXAS	TAGER Interconnects 9 institutions: Austin College, Bishop College, Dallas Baptist College, SMU, TCU, Texas Wesleyan College, University of Texas at Dallas, University of Dallas, and Southwestern Medical School with 12 companies. Four studio classrooms at SMU and one each at TCU, TWC, UD, Bishop, DBC, UTD, SWMS and AC. Uses 6 channel microwave backbone with spurs, a total of 42 channel hops. Has 4 ITFS channels in Dallas and 2 in Ft. Worth. Approximately 160 courses per year. 1,695 student course registrations per year.	x	
WEST VIRGINIA	University of West Virginia Video tape system (Business school) - 2 remote locations		x
WISCONSIN	University of Wisconsin Just starting video tape programming - 1 classroom	x	

Table 1 - continued

	Univ of Arizona	USC	Stanford	CSU	Purdue	Iowa State	Minn.	Cornell	RIT	Penn	Rhode Island	South Carolina	TAGER
Do you use TV classrooms?	Y	Y	Y	Y	Y	Y	Y	Y	No	Y	Y	Y	Y
Do you use TV studios?	No	No	No	Y	No	No	Y	No	Y	No	No	Y	No
Do all of your classes have on-campus students in attendance?	Y	Y	No	Y	Y	Y	Y	Y	No	Y	Y	Y	Y
Are you developing special non-credit short courses for television?	No	No	Y	No	No	No	No	No	No	Y	No	No	Y
Is faculty participation voluntary?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
What about Faculty compensation?													
In dollars	No	No	No	No	No	No	No	No	No	No	No	No	No
In released time	Y	No	No	Y	No	Y	No	-	No	No	No	No	No
As residuals for off-campus use	-	Y	Y	Y	No	No	No	No	No	No	No	No	No
Do you use video tapes of courses provided by others?	No	No	No	No	No	No	No	No	No	No	No	No	No
Do you reuse video tapes of courses on campus?	No	No	No	Y	No	No	No	No	Y	No	No	No	No
Do you use video tapes of university courses to derive off-campus income?	No	Y	Y	Y	No	No	No	No	Y	No	No	Y	No
Do you derive income from leasing facilities to others?	No	No	Y	Y	No	No	No	No	No	Y	No	No	No
Do you participate in a TV consortium with other institutions?	No	No	Y	Y	Y	No	No	No	No	No	No	No	Y
Are you interacting with cable systems?	No	No	No	No	Y	No	No	No	No	No	No	Y	No
Do you use the system during the summer period?	Y	Y	Y	Y	No	No	No	-	Y	Y	No	No	-
Do you use the system during non-academic periods?	Y	Y	No	Y	No	No	No	No	No	Y	Y	No	-
Would you recommend a similar system to another university?	Y	Y	Y	Y	Y	Y	-	-	Y	-	Y	Y	-
Do you use TV Surcharges?	No	Y	No	No	Y	No	Y	Y	Y	No	No	-	Y
Do you count tuition and fee income in justifying cost?	No	No	No	Y	No	Y	Y	Y	Y	Y	Y	-	-
Are you now accruing a surplus?	No	No	Y	No	No	No	No	No	Even	No	No	-	-

UNIVERSITY RESPONSES TO QUESTIONNAIRE

TABLE 2

	Responses	Yes	No	Uncertain	Enthusiastic	Favorable	Good	Very Much	Somewhat	Minimal
ATTITUDES										
What is the view of top management towards participation in televised instruction?	19			1	5	9	4			
What is the view of the participating employees?	20			2	4	6	8			
What is the view of supervisors of participating employees?	18			1	13	4				
PARTICIPATION FACTORS										
Has participation helped in employee recruiting?	12	5	5	2						
Has participation helped in employee retention?	11	4	5	2						
Has participation helped in reaching senior people?	15	10	3	2						
Did you see television as a vehicle for increasing educational participation?	17	15	2							
Would you recommend participation in similar systems to other divisions of your organization?	12	11	1							
WORK COMMITMENTS										
Did you see television (video taped) as a means for overcoming the problems of missed classes due to work commitments?	12	10	2							
Do you allow students time-off during the work day for participation in educational programs?	20	19	1							
COURSE SELECTION PRIVILEGES										
Do you have or would you like Television course selection privileges?	16	15	1							
If you have such privileges, do you use them?	12	12								
TALKBACK										
How important is talkback?	14							8	2	4
Give some indication as to utilization.	14							3	6	5
Would you participate if it were not available?	17	9	4	2					2	
CREDIT, DEGREES, CERTIFICATES										
How important is credit?	18							12	4	2
How important are degrees as goals?	22							16	3	3
How important are "certificates of completion?"	11							7	2	2

THOUGHTS FROM INDUSTRY

Following are representative thoughts from the industry questionnaires. The conclusions are that instructional television systems are effective in providing quality education in a convenient, cost effective way.

"Instructional television makes continuing education an integral part of the job environment."

"More employees are participating because of ease and convenience and participation would be no where near as high without ITV."

"TV has enabled us to more directly relate continuing education to the job. It is justified on the basis of the need to combat technical obsolescence."

"TV cost is not significant in relation to minimization of 'hassle' in commuting for continuing education. TV reduces employee travel time and saves in man hours and lost productivity."

INDUSTRY RESPONSES TO QUESTIONNAIRE

TABLE 3

1967 - 1973

Quarter	Number of Courses	Number of Locations	Number of Students On-campus	Number of Students Off-campus	Total/Yr. Off-campus
Fall, 1967	4	7	105	189	
Winter, 1967	9	9	132	249	
Spring, 1968	8	9	100	206	644
Fall, 1968	12	13	283	341	
Winter, 1969	15	14	305	320	
Spring, 1969	13	15	314	288	949
Fall, 1969	15	14	209	336	
Winter, 1970	14	14	262	295	
Spring, 1970	14	14	162	165	796
Fall, 1970	17	15	232	403	
Winter, 1971	20	19	289	316	
Spring, 1971	18	16	235	202	
Summer, 1971	6	6	67	51	972
Fall, 1971	22	23	410	351	
Winter, 1972	24	22	353	284	
Spring, 1972	23	20	331	253	
Summer, 1972	7	10	79	93	976
Fall, 1972	32	24	527	426	
Winter, 1973	30	28	750	426	
Spring, 1973	31	29	367	275	
Summer, 1973	17	16	96	150	1,277

CSU SURGE
PARTICIPATION SUMMARY

TABLE 4

3 TV Cameras at $1,000.	$ 3,000.
1 Sync generator	1,000.
1 Pan tilt control unit	1,100.
5 TV monitors at $160.	800.
2 Zoom lenses at $1,100.	2,200.
Instruction desk with control unit, split screen generator, and back pack play back recorder	4,000.
Electronic control, amplifiers, cables special room wiring	2,300.
Master Control panel with TV monitors, switching unit	5,600.
Studio classroom air conditioning and necessary remodeling	5,000.
Related labor	5,000.
Total Cost	$30,000.

STUDIO CLASSROOM AND MASTER CONTROL
CAPITAL COSTS

TABLE 5-A

1" VTR's (11) - $995. each	$10,945.	
1/2" VTR's (17) - $700. each	11,900.	
3/4" VCR's (10) - $1,400. each	14,000.	
Sub-total		$36,845.
Shelves and racks	$ 1,800.	
TV monitors (27) - $180. each	4,860.	
Custom switcher	7,000.	
Cabinets	500.	
Cables and carts	250.	
Labor	7,000.	
Sub-total		21,410.
Total		$58,255.

RECORDING FACILITIES COSTS

TABLE 5-B

CSU SURGE COST DATA

TABLE 5

			1972-1973 Level (110 Courses)	Expanded Level (200 Courses)
Administrator,	$24,000.	1/10 time 1/10 time	$ 2,400.	$ 2,400.
Coordinator,	$16,000.	1/2 time 3/4 time	8,000.	12,000.
TV Engineer,	$15,000.	1/5 time 1/5 time	3,000.	3,000.
TV Technicians	$10,800.	2 full time 3 full time	21,600.	32,200.
Secretary,	$ 5,300.	1 full time 1 1/2 full time	5,300.	8,000.
Student Labor, at $2/hr.		3300 hrs. 6000 hrs.	6,600.	12,000.
Travel and Telephone			3,000.	3,000.
Supplies and Spare Parts			8,000.	11,700.
Printing and Mailing Announcements			3,000.	3,800.
			$60,900.	$88,100.

CSU SURGE

BASE OPERATING COSTS

TABLE 6

Institution		Dir. Inst. Cost Sem Cr Hr	Comments	Quality Rating	1972-1973 Dir. Inst Cost* Contact-hour
California:					
Univ. Calif. Berkeley		$62		1	$ 8.72
Univ. Calif. Los Angeles		$53		2	7.49
Calif. State Colleges		$25-33	Range of 5 largest St. College Programs	4	4.08
Stanford		$46		1	6.47
Calif. Inst. Technology		$111		1	15.62
Other Institutions:					
	A	$74	Med. size private inst.	1-	10.41
Group I	B	$46	Large midwest State Univ.	1	6.47
	C	$52	Large midwest State Univ.	2	7.32
	D	$41	Midwest private institution	2	5.77
	E	$56	State Univ. of small state	3-	7.88
Group II	F	$33	Med. size private school in east	3	4.64
	G	$31	Eastern specialized institution	2	4.36
	H	$46	State Univ. of med. size state	3+	6.47
	I	$44	State Univ. of med. size state	4	6.19
	J	$34	Med. size tax-supported inst.	4	4.78
Group III	K	$32	Med. size tax-supported city inst.	4+	4.50
	L	$43	Med. size private university	4	6.05
	M	$40	Large tax-supported inst.	4	5.63

Quality rating scale (based on Cartter ratings of graduate programs):

1. In top 10-12 engineering schools.
2. In top 25 engineering schools, but not in top 10-12.
3. In top 40 engineering schools, but not in top 25.
4. Below top 40 engineering schools.

* These costs are estimated by assuming a 5%/year inflation for 7 years and dividing (sem cr hr) by 15 to obtain contact hours. (Factor used is 1.41)

INSTRUCTION COST INDEX DATA
TABLE 7

	Video Tape Delivery System Number of Classrooms			
	1	2	3	4
Video Cassette Player	$1,150.	$2,300.	$3,450.	$4,600.
TV Set	290.	580.	870.	1,160.
Cart	75.	150.	225.	300.
Totals	$1,515.	$3,030.	$4,545.	$6,060.

CSU SURGE PARTICIPATING FACILITIES COSTS

TABLE 8

Quarter	Sp. '69	Su. '69	Au. '69	W '70	Sp. '70	Su. '70	Au. '70	W '71	Sp. '71	Su. '71	Au. '71	W '72	Sp. '72	Su. '72	Au. '72	W '73	Sp. '73	Su. '73	Au. '73	W '74
TV STUDENTS																				
Hon. Coop.			226	219	225	92	304	234	240	58	195	166	140	45	172	180	150	60	199	166
Non-Reg. Option			8	11	9	9	50	34	15	6	34	21	7	4	25	25	31	14	61	44
Auditor			13	28	55	6	30	32	18	17	28	314	369	35	405	340	318	309	455	368
Total	127	27	247	258	289	107	384	300	273	81	257	501	516	84	602	545	499	383	715	578
NUMBER OF COURSES	18	9	28	30	37	21	46	42	43	17	41	42	43	17	38	42	41	24	45	41
STUDENTS/COURSE (AVG.)	-	3	8.8	8.6	7.8	5.1	6.4	7.1	6.3	4.8	6.3	11.9	12	4.9	15.8	13	12.2	16	15.9	14.1
ACE (NOT INCLUDING MBA STUDENTS)																				
TV STUDENTS		56	320	645	696	322	556	292	269	409	437	603	388	355	341	624	550	319	550	915
NUMBER OF COURSES		4	11	14	12	6	16	10	9	8	15	15	10	10	13	18	15	12	16	20
STUDENTS/COURSE (AVG.)		14	29	46	58	53.7	34.8	29.2	29.5	51.1	29.1	40.2	38.8	35.5	26	35	37	26.6	34.4	45.8
MBA																				
TV STUDENTS							58	72	72	50	97	102	102	69	95	91	91	60	100	85
NUMBER OF COURSES							2	2	2	2	3	3	3	2	3	3	3	2	3	3
STUDENTS/COURSE (AVG.)							29	36	36	25	32	34	34	34	32	30	30	30	33.3	28.3

NUMBER OF PARTICIPATING ORGANIZATIONS

1968-69 (18)	1969-70 (23)	1970-71 (24)	1971-72 (26)	1972-73 (30)	1973-74 (36)

STANFORD ITV PARTICIPATION SUMMARY 1969-1974

TABLE 9

UNIVERSITY ITV SYSTEM CAPITAL BUDGET

	Number of ITFS Channels 1 (dollars)	2 (dollars)	3 (dollars)	4 (dollars)
Consulting and legal fees	20,000	20,000	20,000	20,000
Program management, design engineering and drawings	35,000	35,000	35,000	35,000
Installation and Test	44,000	57,000	69,000	80,000
Studio classrooms equipment	23,000	46,000	69,000	92,000
Studio control	19,000	37,000	56,000	74,000
Master control	8,000	27,000	46,000	49,000
RF transmission equipment emergency power	75,000	88,000	102,000	116,000
Talkback receiving equipment	26,000	27,000	29,000	30,000
Spare parts	6,000	12,000	18,000	24,000
Test equipment	15,000	15,000	15,000	15,000
Room modifications	20,000	40,000	60,000	80,000
Totals	291,000	404,000	519,000	615,000

Minnesota Cost → Stanford Cost →

CAPITAL COSTS

TABLE 10A

Staff		$ 60,739
Staff Benefits (0.17)		11,515
Studio operators - 6,000 x 2.75		16,500
Replacement parts		8,000
Office overhead		9,889
Pick-up and delivery		12,000
	Total	$118,643

For Stanford Courses Only

118,643 - 1,950 (ACE) x 2.75 = $113,280

where 1,950 x 2.75 represents incremental ACE related operator costs

OPERATING COSTS

TABLE 10B

STANFORD COST DATA
TABLE 10

Source of Funds	Allocation of Funds: To TV Network	To Departments	To University
HCP Tuition (TV only)	-	-	94,440
HCP Matching Fee (TV only)	-	78,700(2)	-
HCP TV Surcharge	31,480	-	-
NRO TV Fees	5,300	13,250(1)	-
Auditor TV Fees	25,156	25,169(1)	-
ACE	37,365		-
	99,301(1)	117,119	94,440(2)

NOTE:

1. Of the above funds, the following are clearly identifiable as being incremental as the result of the ITV Network:

   $$99,301 + 13,250 + 25,169 = \$137,720$$

2. The sum of 94,440 + 78,700 = $173,140 is 60% of total HCP income. The estimated portion of total HCP income allocable to students who would not have participated without TV is:

   $$\frac{173,140}{0.6} = 0.45 = \$129.855$$

STANFORD COST RECOVERY BREAKDOWN

1972-1973

TABLE 11

	RF Delivery System Number of Classrooms			
	1	2	3	4
TV Set	$ 290	$ 580	$ 870	$1,160
Cart	75	150	225	300
Antenna, mast, down-converter, power supply, cabling, installation, checkout	1,868	2,298	2,728	3,158
Totals	$2,233	$3,028	$3,823	$4,618

STANFORD PARTICIPATING FACILITIES COSTS
(at given geographic location)

TABLE 12

Basic Unit Costs and Unit Factors

(1)	Unit costs, 1 studio classroom where this is remodeling of existing space	$50,000
	(a) Initial outlay	
	(b) Amortized cost per year assuming 7 year life and 7% annual inflation	10,020
(2)	Unit cost, 1 four channel 2.5 GHz transmitter (no tower)	
	(a) Initial outlay	50,000
	(b) Amortized cost per year; assuming 7 year life and 7% annual inflation	10,020
(3)	Unit cost, one 12 GHz channel hop; a single one-way video, two-way audio channel between two line of sight points	
	(a) Initial outlay	40,000
	(b) Amortized cost per year	8,000
(4)	Unit remodeling cost, 1 average receiving classroom; these may range from 60 seats to as few as 4; costs are $120 per seat, plus monitors ($500 ea), talk-back telephones and wiring, carpeting, drapes and special lighting	
	(a) Initial cost - average classroom	5,000
	(b) Amortized cost per year (10 years)	700
(5)	Instructional cost per course; direct cost of instructor salaries assuming $25,000 (including fringes) for an average salary to each 10 courses over 2 semesters plus summer school	2,500
(6)	Studio Operating cost/course	300
(7)	Network operating and management costs per course (including couriers)	600
(8)	Maximum number of courses per channel; assuming operation from 8:00 AM to 9:30 PM with all classes being 3 semester hours:	50
	Total possible (full year) = 58 for maintenance, etc. = -8 Total usable = 50	
(9)	Maximum practical enrollment per course; past experience indicates that a total course enrollment (in studio and on network) of 100 is about the upper limit if talk-back is to be a feature	100
(10)	Probable maximum average enrollment/course; based upon wide variety of demands and interest (split roughly equally between in studio and on network)	35
(11)	Enrollment will generally split approximately as 55% on campus (in studio) and 45% remote	
(12)	Unit annual costs to maintain receiving equipment:	
	(a) For each 12 GHz channel incoming to user	5,000
	(b) For each 2.5 GHz channel incoming to user	2,500

TAGER COST DATA
TABLE 13

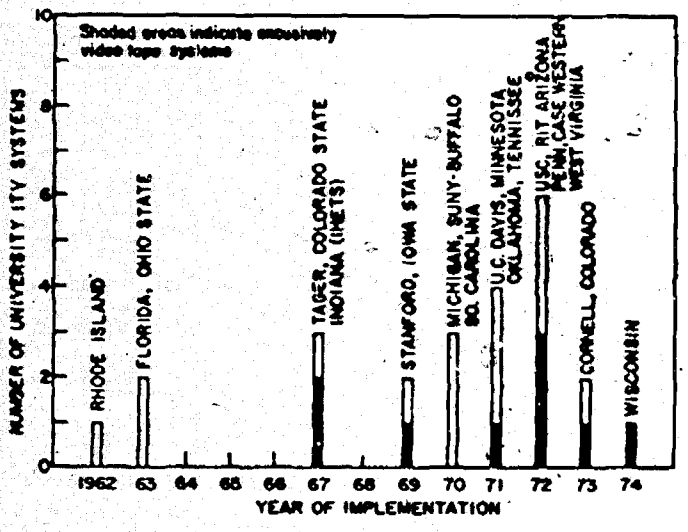

FIG 1

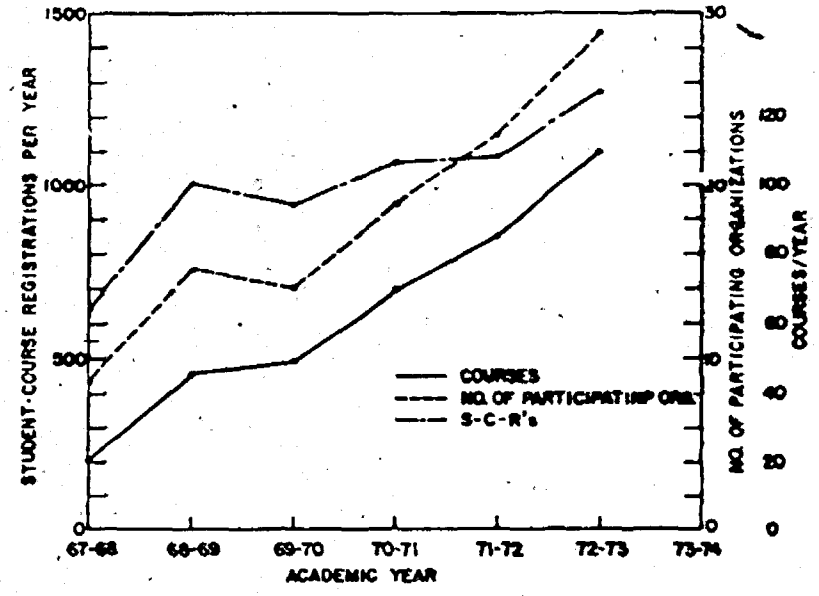

FIG 2

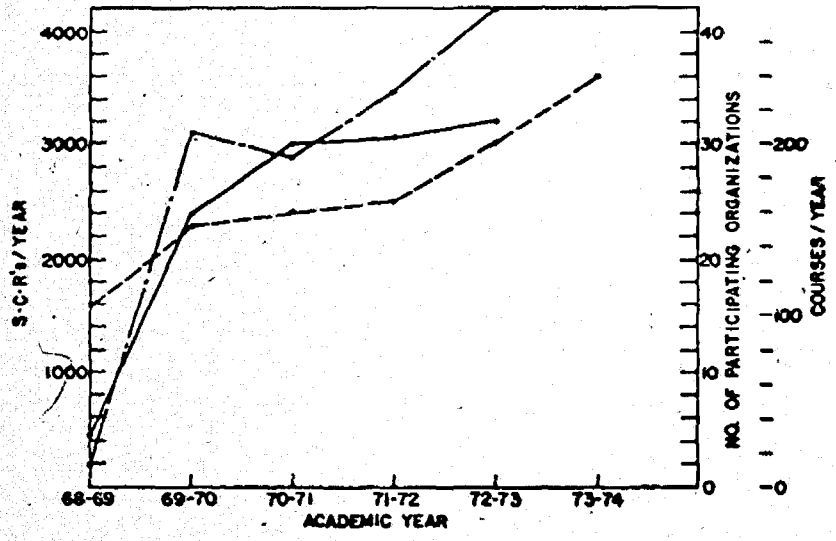

FIG 3

Figure 1 Implementation Rate of University ITV Systems

Figure 2 Colorado State University Participation Pattern

Figure 3 Stanford University Participation Pattern